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Comparison of treatment modalities in syndromic children with Obstructive Sleep Apnea—A randomized cohort study

Shyam Sudhakar Sudarsan *, Vijaya Krishnan Paramasivan, Senthil Vadivu Arumugam, Sathiya Murali, Mohan Kameswaran

Madras ENT Research Foundation (P) Ltd, Chennai, India

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ABSTRACT

Introduction: Obstructive Sleep Apnea (OSA) is a common medical problem in adults that is becoming increasingly recognized in children. It occurs in the pediatric age group, from newborns to teens. More recently, many specialists have estimated OSA prevalence to be between 5 and 6%. However, in syndromic children, the prevalence of OSA can be from 50 to 100%, having a significant effect on their Quality-of-Life. As they are a challenging population for management, it is essential to evaluate them thoroughly before planning appropriate intervention.

Objective: To compare the efficacy of Adenotonsillectomy (T&A) and Continuous Positive Airway Pressure (CPAP) in syndromic children [Down syndrome (DS) and Mucopolysaccharidoses (MPS)] with Obstructive Sleep Apnea (OSA).

Materials and methods: In a prospective, randomized, cohort comparative study, 124 syndromic children (DS and MPS) aged between 6 and 12 years were recruited from a private MPS support group and the Down Syndrome Society, Chennai. A standard assessment was performed on all children who entered the study including a full overnight Polysomnogram (PSG), Epworth Sleepiness Scale-Children (ESS-C) and Quality-of-Life (QOL) tool OSA-18. The children with positive PSG who consented for the study ($n = 80$) were randomly distributed to two groups, T&A group & CPAP group. The children were followed up with repeat PSG, clinical evaluation, ESS-C and Quality-of-Life (QOL) tool OSA-18 for a period of 1 year.

Observation and results: Follow-up was available for 73 syndromic children. Both the groups, T&A group and CPAP group, showed statistically significant ($p < 0.05$) improvement in Apnea-Hypoapnea Index (AHI), ESS-C, QOL from the intervention. In our study, T&A showed equal outcome compared to CPAP. The contrasting feature between the two groups was that CPAP use gave immediate sustained improvement while T&A gave gradual progressive improvement of symptoms over a period of 1 year.

Conclusion: On average, T&A gives equal outcomes as CPAP and it can be suggested as a first-line treatment in this group of syndromic children.

1. Introduction

Obstructive Sleep Apnea (OSA) is a common medical problem in adults that is becoming increasingly recognized in children. It occurs in the pediatric age group, from newborns to teens. Several studies indicate prevalence rates of approximately 2% [1]. More recently, many specialists have estimated OSA prevalence to be between 5 and 6% [2]. If unrecognized and untreated, OSA can lead to neurobehavioral, growth, and cardiovascular sequelae in childhood [3].

Guilleminault et al. (1976) [4], coined the term "Obstructive Sleep Apnea Syndrome (OSAS)" to emphasize the occurrence of this syndrome in non-obese patients. In the same year, they reported the existence of this syndrome in children. Sullivan et al. (1981) [5] devised the first nasal Continuous Positive Airway Pressure (CPAP) machine and reported its efficacy in the treatment of OSA. In children, an Apnea-Hypoapnea Index (AHI) >1 is defined as OSA [6], with absence of airflow for atleast 2 respiratory cycles, with continuing abdominal and chest movements. AHI grading in children was given by Marcus et al. [7] (1992).

In otherwise healthy children, treatment for short-term outcomes indicates that Adenotonsillectomy (T&A) is the most predictable approach to consider, because irrelevant of the size

* Corresponding author at: Sleep Laboratory, Department of Snoring & Sleep Disorders, Madras ENT Research Foundation, No. 1, 1st Cross Street, Off. 2nd Main Road, Raja Annamalaipuram, Chennai 600 028, Tamil Nadu, India.
Tel.: +91 44 24311 411–415.
E-mail address: b7shyam@yahoo.com (S.S. Sudarsan).

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of tonsils or adenoids, it will definitely provide more airway space [8], and is successful in eliminating obstruction in 85–95% [9,10]. On the other hand, CPAP provides continuous pneumatic splinting of the airway and maintains its patency (Rapoport et al., 1996) [11] and is currently recommended as the first-line treatment for OSA children with additional co-morbidity or complex disease (Marcus et al., 2012) [1].

Due to the behavioral problems noted in syndromic children, however, they are a very challenging group to treat with CPAP. They usually require intensive preparation for the first trial. One of the great advantages of nasal CPAP is that it is immediately and demonstrably efficacious in relieving OSA (Lojander et al., 1996) [12]. Another advantage is that it can be offered on a "trial" basis and withdrawn if not tolerated, in contrast to surgical options. This study aims to compare the efficacy of 2 treatment modalities, namely, T&A and CPAP in syndromic pediatric population with OSA and to document if T&A can be advised as a first-line treatment modality for the same.

2. Objective

To compare the efficacy of T&A and CPAP in syndromic children [Down syndrome (DS) and Mucopolysaccharidoses (MPS)] with OSA.

3. Methods

3.1. Participants

The MPS support group started at MediScans, Chennai and the DS Society, Chennai provide health care facilities to the syndromic children by organizing camps and screening for various associated defects/sequelae that occurs due to the disorder. From this pool, along with individual referral cases – study subjects were recruited. One hundred and twenty-four syndromic children aged between 6 and 12 years were referred to our institute for further evaluation. The most common symptoms for which the children were referred were snoring, daytime hyperactivity, urinary incontinence and restless sleep. They were evaluated prospectively by a standardized history, physical examination, audiogram, complete blood investigation, Diagnostic Nasal Endoscopy, Videolaryngoscopy, Dynamic Sleep MRI, Polysomnogram (PSG), X-ray of Nasopharynx, Thyroid function tests, Echocardiography and Electrocardiography (Appendix I). The study was approved by the institute's ethical and scientific committee. The study participants were evaluated by cardiologists/pediatricians/anesthesiologists and considered to be healthy enough to undergo surgery. The total study duration was for 2 years.

3.2. Completion of questionnaire

The parents/caregivers of the enrollee were used as proxy respondents and were provided with the Epworth Sleepiness Scale-Children (ESS-C) [13], OSA-18 [14] questionnaires (Appendices II and III). ESS-C questionnaire was filled on entering the study and on 6 monthly reviews; ESS-C $>$ 10 was suggestive of OSA. OSA-18 questionnaire was filled twice – once during start of the study and once during completion, to assess the effect of intervention on the child's Quality-of-Life (QOL).

3.2.1. Inclusion criteria

1. MPS and DS syndromic children (age 6–12 years) with complaints of snoring and mouth breathing, daytime hyperactivity, urinary incontinence, restless sleep.
2. Obstructive adenoids and tonsils, i.e. grade $>$ 2.
3. Features of OSA on Polysomnogram i.e. AHI $>$ 1.

3.2.2. Exclusion criteria

1. Pediatric patients with previous history of T&A and/or using CPAP.
2. H/o craniofacial reconstruction surgeries/other OSA surgeries.
3. Central apnea.
4. Unfit/unwilling for surgery/medications (Enzyme Replacement Therapy).

3.3. Polysomnogram

The enrollees underwent overnight full PSG. The children with positive PSG who consented for the study were randomly distributed to two groups – T&A group and CPAP group. The PSG machine used in our study was CleveMed Sapphire PSG Type I device, 22 channels unit. The Electrodes were placed by international 10–20 system. Digitized signals were stored on compatible memory storage chips and were analyzed using a computer program (Crystal PSG). Manual scoring based on recent American Academy of Sleep Medicine – AASM guidelines was performed by a trained, certified technician to individually verify the results of the automated scoring system.

3.4. Statistical analysis

3.4.1. Sample size

The study duration was for 2 years during which 124 consecutive syndromic children were recruited and included in the study. Demographic data included age, sex, height, weight, BMI, Neck circumference and associated syndrome. Categorical data is presented as a number (percentage); continuous data is presented as mean ($\pm$SD). The threshold for statistical significance was a p value of $<$0.05. In both the groups, the Student paired t-test was used to compare the mean pre-treatment, 6th and 12th month post-treatment values of AHI, ESS-C and pre- and post-treatment OSA-18 values; the Student unpaired t-test was used to compare the mean post-treatment 12th month AHI, ESS-C and OSA-18 values of both the groups. All of the statistical analyses were performed with a statistical software package (SPSS for Windows, version v20, SPSS Inc., Chicago, Illinois). Initially, treatment was considered successful when the post-treatment AHI $<$ 1. At follow-up, therapy was considered efficacious if 12th month AHI, ESS-C and OSA-18 values showed significant improvement compared to pre-treatment values. Spearman's correlation was used to compute the correlation of OSA-18 scale with AHI.

3.5. Interventions

Coblation T&A was performed for all the subjects in T&A group using Coblator II Arthro Care, Evac 70 Arthro Wand (Arthro Care Corp., Sunnyvale, CA). When compared to conventional Cold dissection, the coblation technique of T&A has been documented to cause less blood loss, pain scale was lower, operative time was less with lesser post-operative bleeding [15]. Since the syndromic children had other co-morbidities, the idea was to use a safe and effective surgical technique so as to provide a faster recovery and uneventful post-operative period. As these children were prone to respiratory depression, they were monitored post-operatively in an Intensive Care Unit (ICU) setup for a minimum of 24 h and then discharged. The post-operative period was uneventful. Post-Tonsillectomy diet instructions and medications were explained to the parents/caregivers.

The children in CPAP group were prescribed ResMed CPAP machines after trial and fitting. The children and parents/caregivers in this group were counseled regarding the CPAP machine and the procedure of CPAP fitting was explained. For the

demonstration/trial and fitting of CPAP machine, the children along with their parents/caregivers were admitted in our hospital Sleep Lab for overnight stay and CPAP demonstration/titration was done.

3.6. Results

Descriptive data of the study group is shown in Table 1. Of 124 children, 20 had negative PSG, 17 declined participation in the study due to social issues. Another 7 did not satisfy the inclusion criteria i.e. the children had previous craniofacial corrective surgeries. Eighty subjects entered the study ($n = 80$). The observed values are shown in Table 2.

3.7. T&A group

Three subjects were lost on follow-up. Thirty-seven subjects completed the study protocol ($n = 37$). Three subjects had persistent OSA (i.e. AHI > 1, Failure rate = 8.1%). Two children developed secondary hemorrhage and were managed conservatively (Complication rate = 5.4%).

3.8. CPAP group

Four subjects were lost on follow-up. Thirty-six subjects completed the study protocol ($n = 36$). Five subjects had persistent OSA (i.e. AHI > 1, Failure rate = 13.8%). One child developed rash on nasal dorsum due to ill-fitting mask and was managed conservatively (Complication rate = 2.7%). An observation, which needs to be highlighted, is that there is no strong statistically significant difference between 6th month and 12th month AHI values ($p = 0.043$) – the children had significant improvement in AHI parameter by 6th month itself and this improvement is maintained over a period of time (12 months). Intolerance of the interface/pressure was the main cause for the failures.

Table 1
Demographic data.

Characteristics	T&A group	CPAP group
Male	22 (59.45%)*	26 (72.22%)*
Age (years)	8.03 (±1.7)**	8.67 (±1.8)**
Height (cms)	120.27 (±26.87)**	137.1 (±15.82)**
Weight (kgs)	28.95 (±14.33)**	37.39 (±12.01)**
Neck circm. (cms)	28.14 (±5.3)**	31.38 (±4.02)**
BMI (Kg/m^2)	19.65 (±6.95)**	19.63 (±2.83)**
Syndrome – MPS (%)	15 (40.54%)*	17 (47.22%)*
OSA severity	23% - moderate OSA	25% - moderate OSA
	77% - mild OSA	75% - mild OSA

* Categorical data – number (percent %).
** Continuous data – mean (±SD).

In both the groups, the 12th month mean AHI values when taking the T&A group ($n = 37$) and CPAP group ($n = 36$) individually as a single entity was >1 (i.e. T&A AHI – 1.06 ± 0.74, CPAP AHI – 1.07 ± 0.57) which may suggest that the treatment modality was not effective. The failure rates were mostly observed in those children who had a high pre-treatment AHI score.

3.9. T&A group vs CPAP group

By statistically comparing the values in Table 2, it is evident that, in T&A group – pre-op, 6th and 12th month AHI, ESS-C values show a good outcome; in CPAP group – pre-treatment, 6th and 12th month AHI, ESS-C values show a good outcome (kindly refer p value[1,2,3] in Table 2). However, statistically comparing the 12th month values of AHI, ESS-C of both the groups, the statistical difference was not significant indicating equal outcomes (kindly refer p value[4] in Table 2). Resolution of OSA after treatment (cure) defined as post-treatment AHI score <1 was seen in 65 children (89.04%) but individually T&A group cure rate was 91.89%, CPAP group cure rate was 86.11%. Mean OSA-18 scores recorded during the survey are depicted in Table 3.

A statistically significant improvement was observed in the total OSA-18 scores and in the domains of "sleep disturbance", "physical suffering" and "daytime problems". The "emotional distress" and "caregiver concerns" domains showed improvement but it was not statistically significant. Spearman's correlation between pre- and post-treatment ($r = 0.182$, 0.234 respectively) AHI and OSA-18 showed weak positive correlation (Fig. 1). The impact on QOL had shifted from large to moderate in both the groups after the specific intervention.

4. Discussion

The literature on pediatric OSA in DS and MPS is composed of case reports, small selective prospective and retrospective studies of patients known to have OSA, and reviews. This is a prospective study on 2 syndromic pediatric populations with confirmed OSA on PSG and evaluated for efficacy of 2 treatment modalities – T&A (first-line treatment in otherwise healthy children), CPAP (first-line treatment in complex OSA). The total study population size is large compared to previous studies.

Stebbens et al. (1991) [16] evaluated DS children primarily in home studies using only oximetry, respiratory inductance plethysmography, and $etCO_2$ measurements. Levanon et al. (1999)[17] studied 23 children with DS and Strome et al. (1985) [18], studied 4 patients with MPS and documented OSA. In a recent review, Semenza and Pyeritz (1988) [19], looked retrospectively at 21 patients with various MPS; 12 of these patients had symptoms suggestive of OSA. To our knowledge,

Table 2
Observed values of the study groups.

Variable	T&A (n = 37)			CPAP (n = 36)			p value[4]
	Pre-Op	Post-Op 6 m	Post-Op 12 m	No CPAP	With CPAP 6 m	With CPAP 12 m	
AHI	3.83 ± 1.36	2.62 ± 0.87	1.06 ± 0.74	3.46 ± 1.67	1.09 ± 0.61	1.07 ± 0.57	0.949
p value**	0.001[1]	0.001[2]	0.001[3]	0.001[1]	0.001[2]	0.51[3]	
ESS-C	13.76 ± 1.32	10.95 ± 0.91	5.46 ± 1.35	14.44 ± 2.18	10.86 ± 1.57	7.86 ± 1.69	0.741
p value**	0.001[1]	0.001[2]	0.001[3]	0.001[1]	0.001[2]	0.001[3]	

*Data are mean ± SD unless otherwise specified.
** p value < 0.05 is significant.
p value [1] statistical significance between Pre-treatment and 12 m Post-treatment.
p value [2] statistical significance between Pre-treatment and 6 m Post-treatment.
p value [3] statistical significance between Post-treatment 6 m and Post-treatment 12 m.
p value [4] statistical significance between 12 m Post-treatment values of both groups.

Table 3
Quality-of-Life instrument (OSA-18).

Data	OSA-18 Mean domain Score								OSA-18 Total score	
	Sleep disturbance		Physical suffering		Emotional distress		Caregiver concern	Daytime problems		
	T&A	CPAP	T&A	CPAP	T&A	CPAP	T&A CPAP	T&A CPAP	T&A	CPAP
PreTx	27.02 ± 1.16	26.78 ± 0.76	26.08 ± 0.92	25.78 ± 0.98	18.03 ± 0.93	18.67 ± 1.17	27.05 ± 1.02 27.19 ± 1.01	18.78 ± 1.11 18.47 ± 0.61	116.97 ± 2.25	116.87 ± 1.3
PostTx (12m)	10.64 ± 0.82	10.72 ± 0.81	11.27 ± 0.77	11.11 ± 0.94	17.62 ± 3.04	18.50 ± 1.32	26.62 ± 2.19 26.58 ± 1.79	7.43 ± 0.73 7.38 ± 0.68	73.59 ± 4.14	75.02 ± 2.5
p value**	0.001	0.001	0.001	0.001	0.482	0.057	0.254 0.106	0.001 0.001	0.001	0.001

** *p* value < 0.05 is statistically significant.

after extensive PubMed and internet search, this is the first study enrolling a large number of specific syndromic pediatric OSA patients from referral and support societies. So far, earlier studies enrolled only 1 syndromic population vs healthy control group. The syndromes discussed in our study include cohorts of both DS and MPS along with QOL instrument (OSA-18) as a measure of clinical outcome.

4.1. Prevalence of OSA in syndromic children

In our study, the prevalence rate of OSA in DS was 86.67% and 72.72% in MPS. The study was done on all children who were referred by the respective societies as part of their routine evaluation. The prevalence of OSA in children with DS is reported to be between 50% and 100%. Marcus et al. (1991) [20], reported OSA documented by PSG in all 53 children with DS enrolled in their study. Dyken et al. [21] (2003) studied 19 children with DS using PSG. They found that OSA was present in 79% of these children and the severity of the sleep disturbance was directly related to BMI and inversely related to age. Strome et al. (1985) [18], described 4 MPS patients, all with OSA documented by PSG. Semenza and Pyeritz et al. [19] (1988) confirmed OSA in 8 MPS patients from 9 suspected candidates. Prevalence in earlier study was 100%, while in the latter study it was 88.89%. OSA is being increasingly recognized in DS [22]. Predisposing factors for OSA in DS are multiple apart from adenotonsillar hypertrophy [23–25]. In research done by Marcus et al. [20] (1991) and Brouilette et al. [26] (1984), even though parents reported no significant symptoms of obstruction, 100% of DS children had abnormal studies. The first report of OSA in patients with MPS came in 1980 by Perks et al. [27]. In studies done by Strome et al. (1985) [18], Semenza and Pyeritz (1988) [19] on MPS children, PSG documented OSA is very much evident.

4.2. Sex incidence

In the children with positive OSA, the male/female distribution with DS was 1.2:1 and with MPS was 1.9:1. A study by Stebbens et al. [16] (1991), on Sleep related Upper Airway Obstruction in a cohort with DS had a male/female ratio of 1.3:1, similar to our baseline demographics. Nashed et al. [28] (2009), on OSA in children with MPS, reports the ratio to be 2.6:1, which was quite high compared to our study.

4.3. BMI category (kg/m^2)

The subjects in our study had a mean baseline BMI of 19.65 ± 6.95(T&A) and 19.63 ± 2.83 (CPAP) of which 63 (78.75%) had BMI < 25 and 17 (21.25%) had BMI > 25. In a study by Nashed et al. (2009), [28] evaluating MPS children with OSA, the mean BMI was 19.9 (range 13.7–22.2). Dyken et al. [21] (2003), study on prospective polysomnographic analysis of OSA in children with DS had a mean BMI of 23.1 ± 6.4 with a sample size of 20.

4.4. T&A vs CPAP

In our study, T&A showed equal outcome compared to CPAP in case of syndromic children with OSA with a moderate impact on their QOL (Post-treatment total OSA-18 scores > 60). A striking observation from values of CPAP group was that, the child, if tolerant of a nasal mask/CPAP, showed statistically significant improvement by 6 months itself and this was maintained over a period of time. But in T&A group, the improvement was gradual and statistically significant over a period of time (1 year). These improvements were also clinically significant.

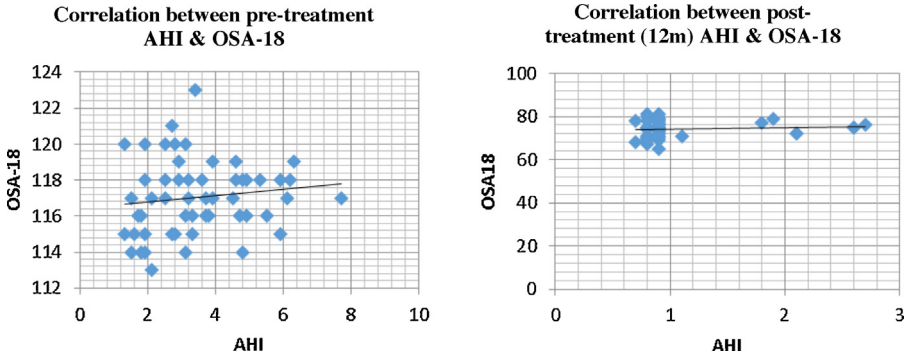

Fig. 1. Correlation between AHI and OSA-18.

In a study by Santamaria et al. (2007) [29] on MPS patients who underwent T&A for OSA, reported definite improvement of symptoms. Ginzberg et al. [30] (1990) also documented successful use of CPAP for OSA in MPS.

Donaldson et al. [31] (1988) demonstrated effectiveness of T&A in DS, though they cautioned that these patients should be serially assessed. Alleviation at other sites was difficult and less effective, as demonstrated by Brown et al. [32] (1989) in DS. Extensive studies have been conducted on treating pediatric OSA using T&A or CPAP but most of them were not randomized/retrospective/small sample/use incomplete PSG as concluded in a meta-analytic study by Gozal et al. [33] (2003). Nashed et al. (2009) [28], documented successful CPAP treatment in MPS children. Other studies compared 2 or more procedures. Merrell et al. [34] (2010) documented that T&A was less effective in DS children.

4.5. Complications

The complication in T&A group was secondary hemorrhage and that in CPAP Group was a skin rash on nasal dorsum due to ill-fitting mask. Stebbens et al. [16] (1991), reported that tracheostomy was needed for overcoming pulmonary hypertension but presented severe difficulties for the children's parents, particularly in relation to the high amount of mucosal secretions associated with DS. In a retrospective study by Goldstein et al. (1998) [35], discussing post-operative complications in DS children after T&A – they concluded that respiratory complications requiring intervention were 5 times more compared to otherwise healthy children.

4.6. Quality-of-life (QOL) improvement

Distinct improvements in QOL have been reported in pediatric OSA after T&A, regardless of the severity of the disorder in studies by Mitchell et al. [36] (2004). Compared to our study, these studies reported a significant improvement in the overall OSA-18 scores and in the domains of "sleep disturbance" and "physical suffering", and not a definitive improvement in other domains. The improvement in QOL was nevertheless significant for the entire cohort, and the changes in OSA-18 scores were similar between the 2 groups. In this study, the change of OSA-18 scores was not parallel with either the pre-/post-treatment AHI scores – this could be attributed to associated syndromic illness in this group of children. This finding indicates that PSG and the OSA-18 survey are related but complementary, since they assess different but associated constructs.

De Serres et al. [37] (2002), administered the OSA-6 Survey, a validated health-related QOL instrument, to the caregivers of 101 children from 7 tertiary care pediatric otolaryngology practices across the United States, before and after T&A performed for treatment of sleep-disordered breathing. Domains of the survey most affected at initial evaluation were physical suffering, sleep disturbance, and caregiver concern. Postoperatively, 90% of children had improvement in QOL.

Goldstein et al. (2002) [38], administered OSA-18, along with a standardized measure of children's behavior, the Child Behavior Checklist, to the caregivers of 64 children before T&A and 3 months postoperatively. As in the study by De Serres et al. (2002) [37], the change in the impact on QOL was highly significant after T&A. In both the group of patients, the noted changes were not only statistically significant but also clinically meaningful as it showed a definite improvement in their quality of life.

4.7. Failure rates

The major factor for failure noticed in T&A group (8.1%) was compensatory hypertrophy of lingual tonsils. Another factor that merits mention in T&A group is the multilevel block/upper airway neuromuscular hypotonia. For these patients CPAP support was given to relieve the obstruction. The major factors for failure in CPAP Group (13.8%) were poor compliance, mental retardation and obstructive adenoids and tonsils grade 4. This group of children was advised T&A or BiPAP titration. Similar findings were noted in a study by Donnelly et al. (2004) [25].

4.8. Limitations

This was a referred sample of children with a suspicion of OSA and conclusions may be less applicable to a larger, more heterogeneous sample of children with DS/MPS associations. For the number of children who were lost to follow-up, though negligible in our study (8.75% – 7 children), the effect of the intervention on OSA and the extent of improvement in QOL remain unknown. Private health information was removed from the information culled from the study and stored in a secure database. Hence, effect of intervention in different subtypes of MPS could not be outlined. Individual outcome needs to be elaborated as well. Since our study population was specifically limited to those with Down syndrome or Mucopolysaccharidoses, it may not be appropriate to generalize our findings and conclusions to children with other syndromes.

5. Conclusion

With respect to surgical therapy for OSA in high-risk children, T&A should be viewed as beneficial rather than uniformly curative. Evaluation of the outcome of T&A for OSA in high-risk children is complex, since this surgery does not address the other co-morbidities that affect them. It is the goal of future research to establish adjunct therapies to maximize the benefits of T&A for

OSA in high-risk children. Hence, T&A as such can be used as a first-line approach for treating OSA in syndromic pediatric population provided the selection of cases is stringent, giving good outcomes comparable to CPAP in effectiveness, while better in terms of compliance.

CPAP is effective in a controlled/attended environment. The failure rates could be attributed to poor compliance which was a major factor apart from static obstruction by adenoids and tonsils. Good compliance isn't what makes T&A a more successful treatment, but rather poor compliance is what may make CPAP a less successful treatment. However, as residual disease is quite common after any mono-therapy, the long-term outcomes need to be evaluated to assess overall improvement in this particular population. If residual disease is noted, it indicates the necessity for a personalized individual re-evaluation.

Acknowledgements

I would like to acknowledge the Down Syndrome Society, Chennai and the Mucopolysaccharidoses (MPS) Support Group, Chennai for providing the necessary candidates for this study.

Appendix I

Appendix I

Study Proforma

S. No. :

Group: T&A / CPAP

Name :

Age / Sex : Date of birth:

Duration of complaint :

Systemic Illness / Syndrome :

ESS-C Score :

Significant Medical History :

ENT examination :

Audiogram :

Complete blood investigation :

Thyroid function tests :

Diagnostic Nasal Endoscopy :

Videolaryngoscopy :

Polysomnogram (PSG) :

Dynamic Sleep MRI :

X-ray of Nasopharynx :

Echocardiography :

Electrocardiography :

Cardiologist's opinion :

Pediatric opinion :

Anesthesiologist's opinion :

Date of study :

IM No. :

IP No. :

Phone No. :

Height (Cms) :

Weight (Kgs) :

Neck circumference (Cms):

BMI :

Variable	Pre Treatment	Post Treatment 6 months	Post Treatment 12 months
AHI			
ESS-C			
OSA-18		--	

Appendix II

Epworth Sleepiness Scale-Children

Use the following scale to choose the most appropriate number for each situation.
0 = would never doze
1 = slight chance of dozing
2 = moderate chance of dozing
3 = high chance of dozing

S. no.	Situation	Chances of dozing
1	Sitting and reading	0 / 1 / 2 / 3
2	Watching Television	0 / 1 / 2 / 3
3	Sitting inactive in a public place (e.g. a movie theater or a classroom)	0 / 1 / 2 / 3
4	As a passenger in a car for an hour without a break	0 / 1 / 2 / 3
5	Lying down to rest in afternoon when circumstances permit	0 / 1 / 2 / 3
6	Sitting and talking to someone	0 / 1 / 2 / 3
7	Sitting quietly after a lunch	0 / 1 / 2 / 3
8	Doing homework or taking a test	0 / 1 / 2 / 3

Appendix III

Quality-of-Life Questionnaire for children with Obstructive Sleep Apnea (OSA-18)							
Situation	None of the time	Hardly any of the time	A little of the time	Some of the time	A good bit of the time	Most of the time	All of the time
Sleep disturbance							
During the past 4 weeks, how often has your child had…							
…loud snoring?	1	2	3	4	5	6	7
…breath holding spells or pauses in breathing at night?	1	2	3	4	5	6	7
…choking or gasping sounds while asleep	1	2	3	4	5	6	7
…restless sleep or frequent awakenings from sleep?	1	2	3	4	5	6	7
Physical symptoms							
During the past 4 weeks, how often has your child had…							
…mouth breathing because of nasal obstruction?	1	2	3	4	5	6	7
…frequent colds or upper respiratory infections?	1	2	3	4	5	6	7
…nasal discharge or runny nose?	1	2	3	4	5	6	7
…difficulty swallowing foods?	1	2	3	4	5	6	7
Emotional distress							
During the past 4 weeks, how often has your child had…							
…mood swings or temper tantrums?	1	2	3	4	5	6	7
…aggressive or hyperactive behavior?	1	2	3	4	5	6	7
…discipline problems?	1	2	3	4	5	6	7
Daytime functions							
During the past 4 weeks, how often has your child had…							
…Excessive daytime drowsiness or sleepiness?	1	2	3	4	5	6	7
…poor attention span or consciousness?	1	2	3	4	5	6	7
…difficulty getting out of bed in the morning?	1	2	3	4	5	6	7
Caregiver concerns							
During the past 4 weeks, how often has your child had…							
…caused you to worrying about child's general health?	1	2	3	4	5	6	7
…caused concern that your child is not getting enough air?	1	2	3	4	5	6	7
…interfered with your ability to perform daily activities?	1	2	3	4	5	6	7
…made you frustrated?	1	2	3	4	5	6	7

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